SECTION 7. DESCRIPTION OF RECOMMENDED ALTERNATIVE

7.1 DESCRIPTION OF THE RECOMMENDED PLAN

The recommended plan for ecosystem restoration of the 2.5-mile Mill River corridor in Stamford, Connecticut has the following restoration measures:

- Restoration of the river channel at Mill River Park, including dam removal and restoring the channel to a riffle-and-pool morphology, as in Alternative 2 (includes Sites 11, 12, 13)
- Restoration of 1.53 acres of the riparian corridor through planting of native woody and herbaceous vegetation and removal of exotic and invasive plant species [Site 9 (0.15 acres), Site10 (1.02 acres) and Site 18 (0.36 acres)]
- Restoration of two 0.4-acre tidal wetland through re-grading banks and planting native salt marsh vegetation (Site 2 and Site 6)
- Removal of abandoned concrete blocks and gate structures directly beneath the Pulaski Street Bridge to restore fish passage (Site 1)
- Incorporation of a trail system to connect the greenway and parks along the river corridor (Sites 10, 11, 12, 13) (Removal of the dam and walls affects existing pedestrian walkways and trails. These walkways would be re-established for public safety purposes and connection to other existing sidewalks, trails, and open space areas downstream of the dam.)

The recommended actions involve nine sites along the lower 2.5 miles of Mill River (Sites 1, 2, 6, 9, 19, 11, 12, 13, and 18) of the 20 sites identified in this study. The recommended actions, along with current conditions, for each of the nine sites are described in Table 10. The locations and topography of the nine sites are shown in Figures 15, 16, and 17. All restoration activities would be completed within the riparian corridor and on publicly held lands.

The recommended alternative includes the removal of the Main Street Dam and concrete retaining walls within Mill River Park. Removing the Main Street Dam would facilitate fish passage, as well as re-establish a natural stream channel with restored in-stream habitat through the downtown reach of the Mill River. The configuration of the natural channel design, along with the selective placement of boulders and other rock structures in the stream channel, would re-establish a pool-and-riffle sequence within the park reach. Deeper pools in the flowing stream would be self-maintained by natural flushing during high river flows. The vertical concrete walls would be removed and a well-vegetated, natural floodplain would be restored that would serve as a riparian buffer for the aquatic habitat, provide flood storage for large discharge events, create public open space, and improve access to the river.

Removing the Main Street Dam would restore passage for a broad range of fish and other aquatic species to the Mill River by re-establishing habitat connectivity between the river and the ocean. By establishing a geomorphologically stable channel within the park that approximates naturally occurring conditions in the watershed, the reach would be self-maintaining. Trails and/or boardwalks would accommodate recreational access to the river and protect banks and riparian vegetation from disturbance.

Table 10. Recommended Restoration Actions

Potential Projects Identified During Field Investigations		
Site Location	**Current Conditions**	**Proposed Restoration Action**
1	Abandoned concrete blocks and gate structures directly underneath Pulaski Street Bridge. Structures block fish passage at lower tides.	Remove portions of the fish blockage to restore fish passage at low tide.
2	Tidal flat dominated by *Phragmites* sp. Area lies directly in front of city-owned property.	Tidal wetland restoration. Restore area to a tidal wetland by regrading and planting of desired vegetation. Invasive species removal.
6	Tidal flat dominated by *Phragmites* sp. Area lies directly in front of city-owned property.	Tidal wetland restoration. Restore area to a tidal wetland by regrading and planting of desired vegetation. Invasive species removal.
9	Empty lot located on the east bank of the river downstream of the Main Street bridge. Area is dominated by invasive exotics. Provides little shading or habitat value.	Riparian restoration by planting of desirable riparian species. Regrade lower portion to include a wetland area. Manage or remove any exotic species. Trail system to connect greenway along river corridor.
10	Floodplain located on the east bank of the river just downstream of the Main Street bridge. Area is dominated by invasive exotics. Provides little shading or habitat value.	Riparian restoration by planting of desirable riparian species. Regrade lower portion to include a wetland area. Manage or remove any exotic species. Connect trail system in Mill River Park to City-provided trail that connects to Main Street Bridge pedestrian crossing.
11	Retaining wall located on west bank of river directly adjacent to Mill Pond Road. Has numerous stormwater discharge pipes. Constriction made by road and wall does not allow a walkway for foot and bike traffic.	Structural reinforcement and stabilization. Vegetation planting at base of wall. Incorporate a sidewalk for pedestrian and bike traffic to connect park system.
12	Main Street dam forming the Mill Pond. Dam is failing and needs structural reinforcement. Collects trash and causes sedimentation behind dam within Mill Pond.	Remove Main Street dam and restore a natural river channel, which includes a number of pool and riffle sequences.
13	Mill Pond located in downtown Stamford. Currently a trap for sediment and trash. Vertical concrete walls provide little habitat value. Large population of Canada geese and mute swans.	Restore a natural correct river channel. Remove concrete walls and restore floodplain that incorporates a trail/boardwalk system as well as overlooks and educational facilities. Maintain as many cherry trees as possible within Mill Pond Park.
18	Riparian corridor on west bank of Mill River located between Wright Technical School and Mill River. Vegetation is composed primarily of Japanese knotweed, an invasive exotic. Provides little shading or habitat value.	Riparian restoration by planting of desirable riparian species. Manage or remove any exotic species.

Mill River Recommended Restoration Sites

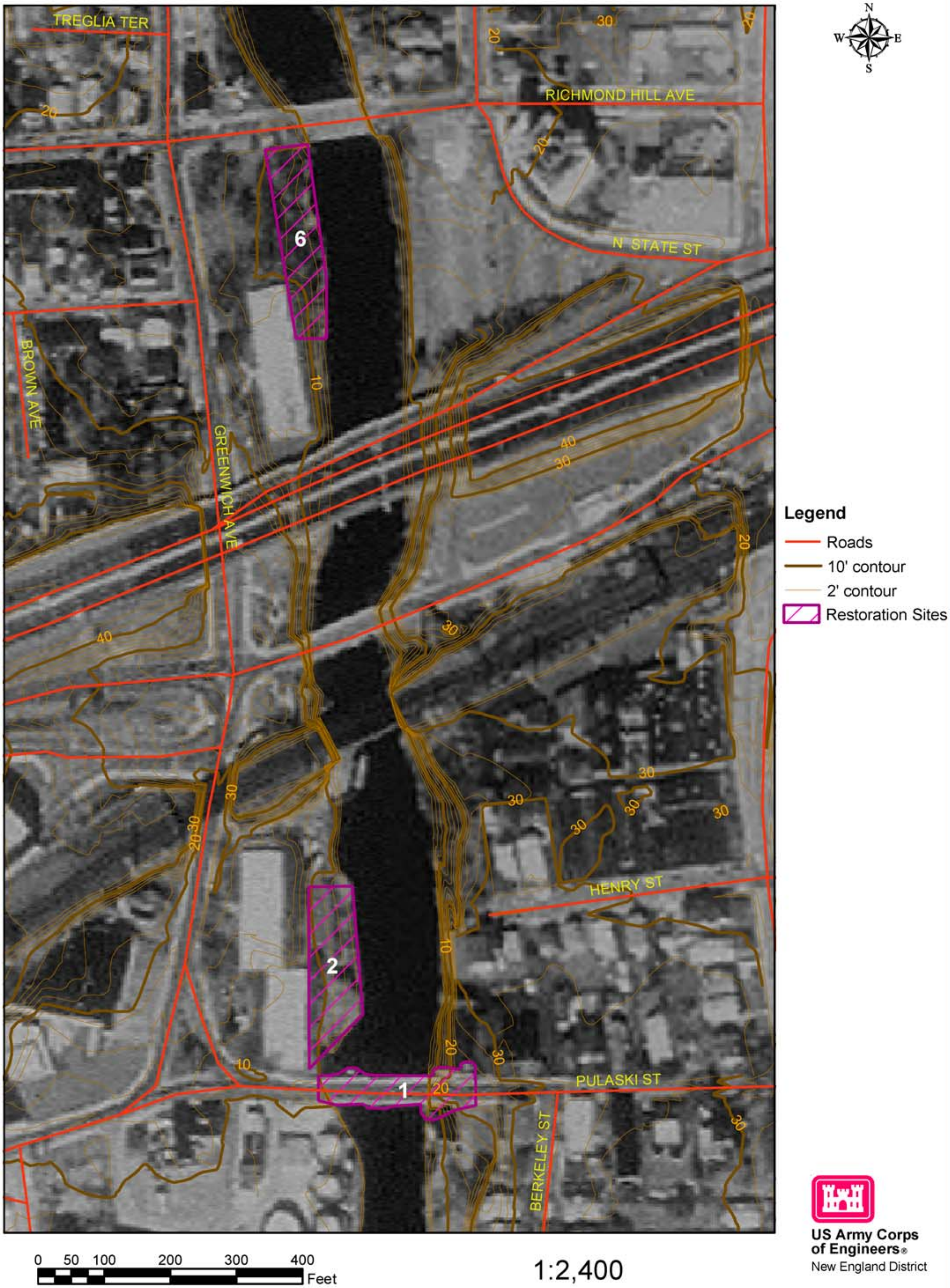

Figure 15. Recommended Mill River Restoration Locations (Sites 1, 2, and 6) (Map 1 of 3)

Mill River Recommended Restoration Sites

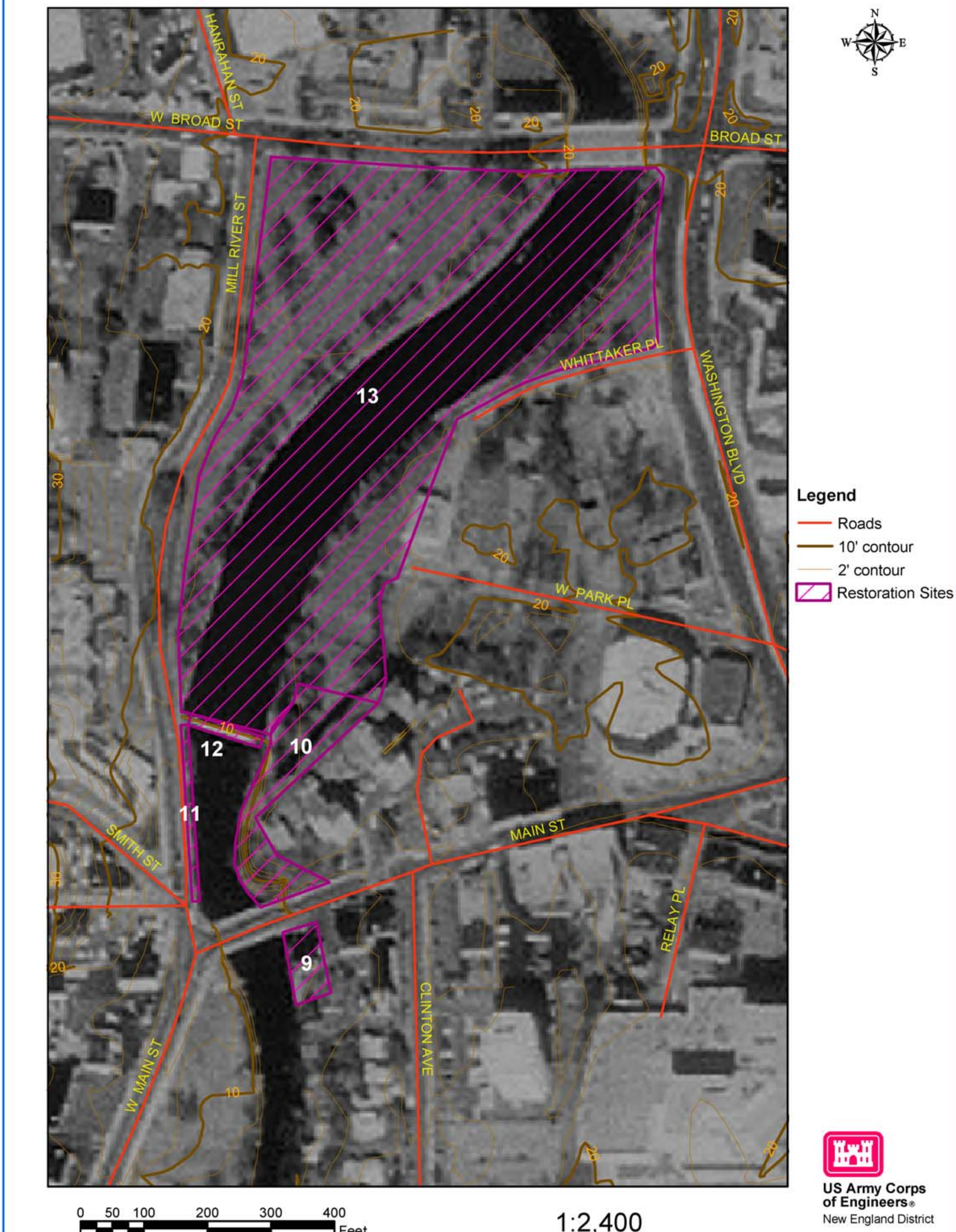

Figure 16. Recommended Mill River Restoration Locations (Sites 9, 10, 11, 12, and 13) (Map 2 of 3)

Mill River Recommended Restoration Sites

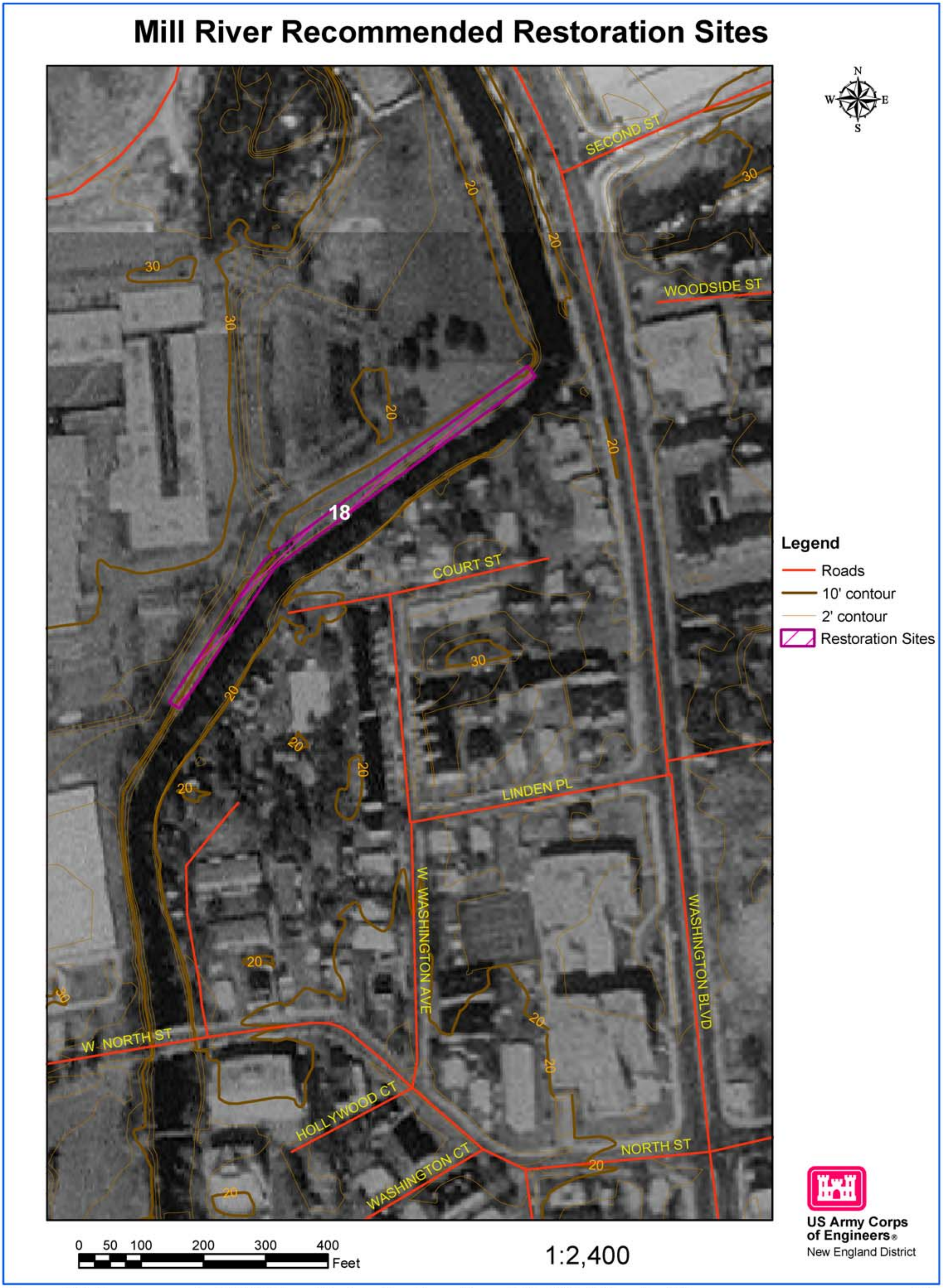

Figure 17. Recommended Mill River Restoration Locations (Site 18) (Map 3 of 3)

7.1.1 Mill River Park Ecosystem Restoration (Sites 11, 12, and 13)

The majority of restoration activity would be focused on Mill River Park and the removal of the Main Street Dam and associated retaining walls (Sites 11, 12, and 13). A preliminary design for the Mill River Park restoration is shown in Figures 18 and 19. Accumulated sediment behind the Main Street Dam would be excavated and the channel re-graded and re-shaped to restore a natural stream channel within the park. The in-stream riffle-pool sequence between the Broad Street Bridge and the present location of the dam would be established by the design channel's gently meandering thalweg (center of low-flow channel).

Approximately 18,600 cubic yards of sediment would be removed from Mill Pond. The sediment to be excavated may require additional testing to verify permitted disposal. All materials determined inappropriate for disposal in residential and/or industrial/commercial areas would be transported to an approved site, such as Manchester Municipal Landfill in Manchester, Connecticut. The cost for sediment disposal is discussed in more detail in section 6.3. For more information on sediment quality see section 3.2.6. The restoration of natural channel banks and floodplains would be accomplished by re-grading approximately 26,000 cubic yards of soil material currently located behind the retaining walls to shape the new channel valley profile. An additional 2,000 cubic yards of loam would be placed on the site to help re-establish vegetation.

The channel's planform configuration, gradient, and cross-section geometry are designed to provide a geomorphologically stable channel that would improve fish passage and habitat (Figures 8 and 9, Section 4). The concept design for a geomorphologically stable channel above the dam was developed at a feasibility level of detail using available data, including cross sections from FEMA flood insurance studies (1993) for reference reaches upstream and downstream of the impoundment; bathymetric and sub-sediment elevations surveyed in the Mill River Park reach (Appendix J); hydrologic data from FEMA (1993) and the city of Stamford (2001); and a map of the project area provided by the city that shows topography and infrastructure. Design-level specifications would require more detailed field surveys of the project area to gather the necessary geomorphic and geotechnical information. Further hydrologic, hydraulic, and sediment transport and disposal analyses may also be needed to support design-level specifications.

Determining appropriate bankfull channel dimensions is critical for establishing a geomorphologically stable channel. For a large variety of rivers throughout North America, bankfull channel cross-section geometry has been shown to correspond with a discharge that has a recurrence interval of approximately 1.5 years in the annual flood series (Dunne and Leopold, 1978). Data for the 2-year recurrence interval discharge (Q2) were available for the reference cross section downstream of the project area. These data were used to approximate the bankfull discharge and estimate appropriate bankfull channel cross-section dimensions of the project area design channel. The bankfull channel geometry can also be approximated by using regional curves derived for the Eastern United States that relate bankfull channel dimensions with drainage area (Dunne and Leopold, 1978). The channel geometry estimated using the regional curves is similar to that determined using the Q2-flood levels. Dimensions of the upstream reference cross section (for which no Q2 data were available) were also compared to the project area design channel using the Q2-flood levels and found to be similar.

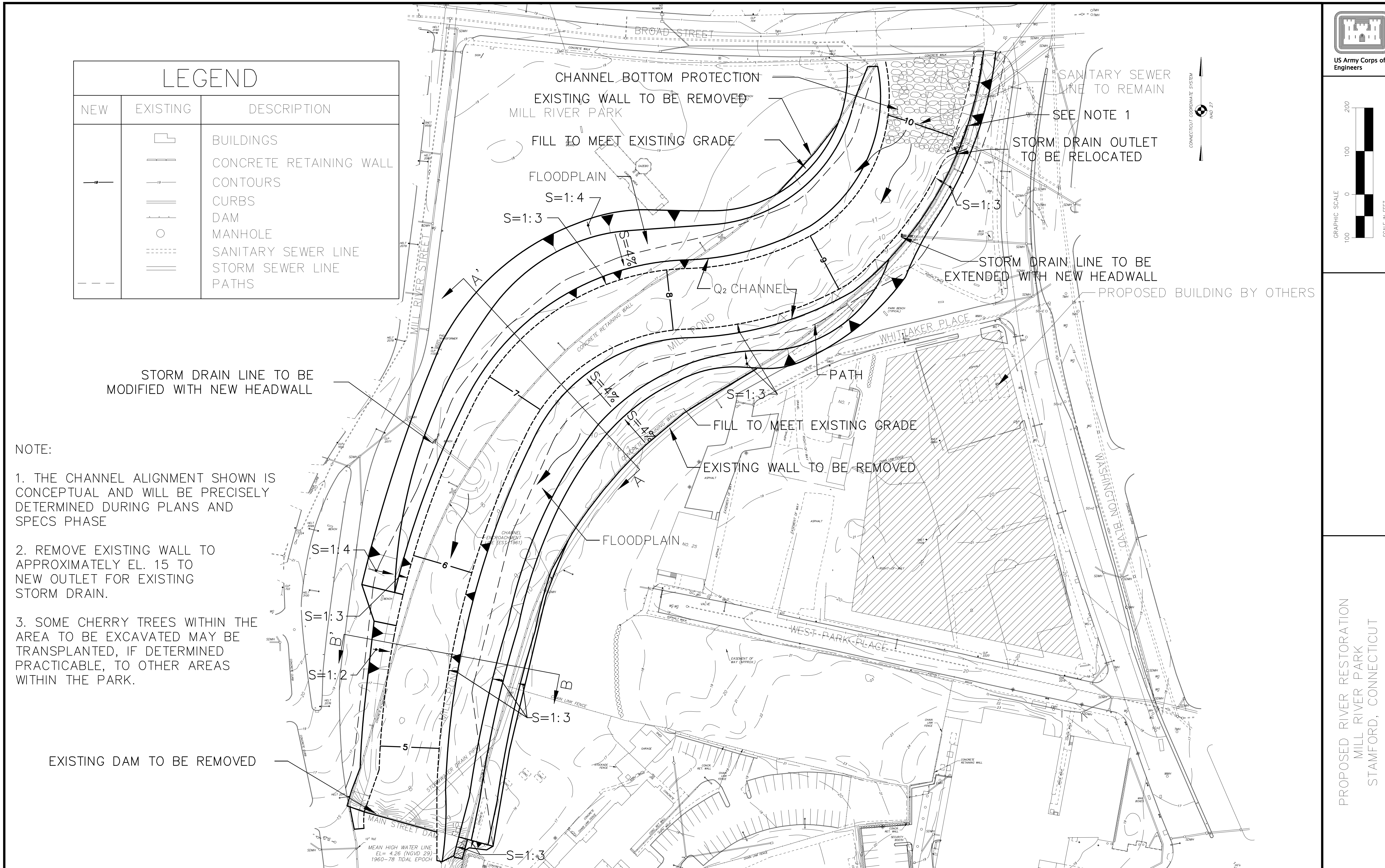

FIGURE 18 Proposed Mill River Channel Restoration and Dam Removal within Mill River Park

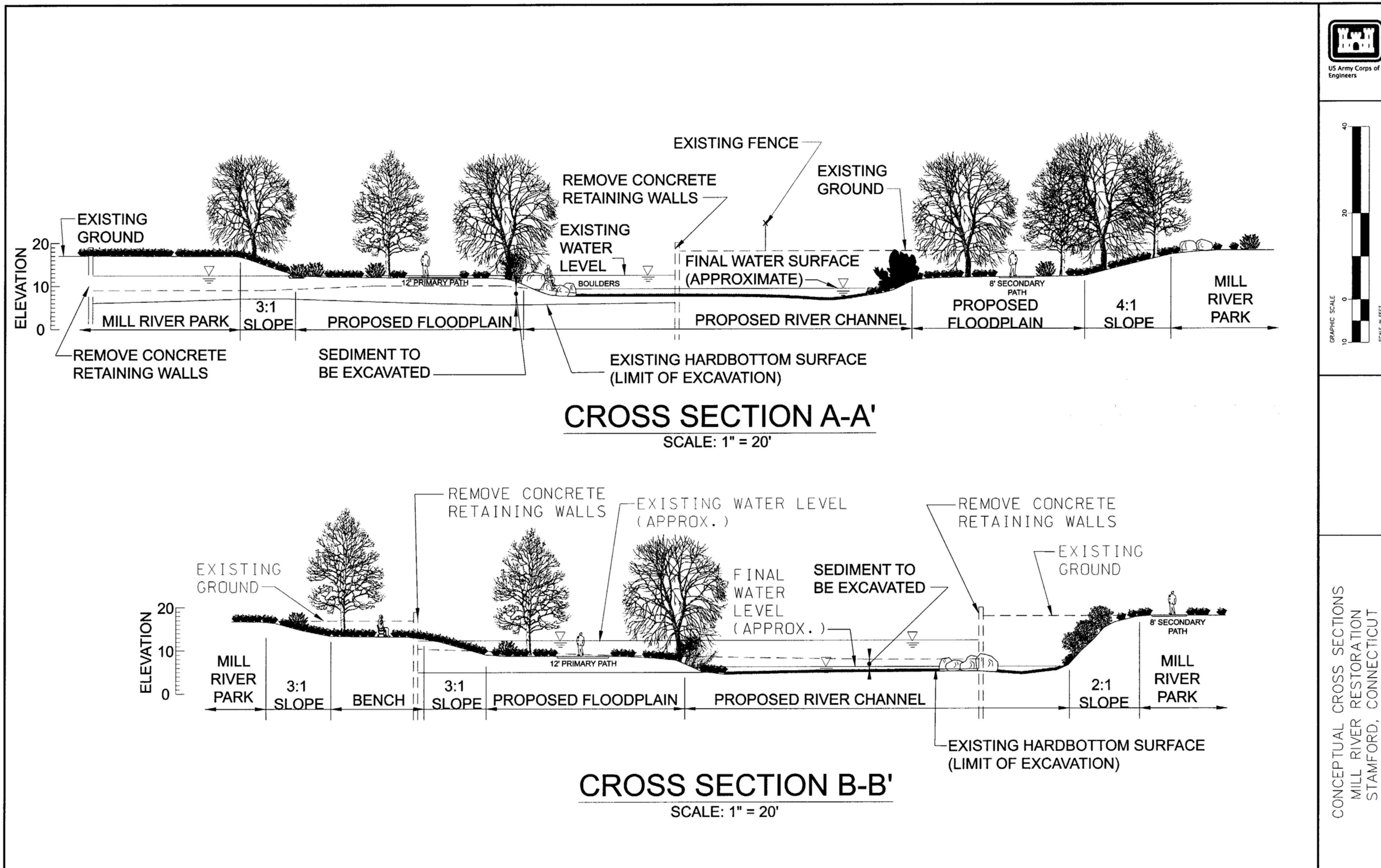

Figure 19. Cross Sections of Proposed Restoration and Dam Removal within Mill River Park (See Figure 15 for locations of cross sections)

Bathymetry and sub-sediment elevations at the plotted FEMA cross sections within the park, as well as bed elevations estimated from the upstream and downstream reference FEMA cross sections, were used to establish bed elevations that reasonably approximate the pre-impoundment channel gradient, while at the same time accommodating project constraints. Inspection of topographic maps of the lower Rippowam basin, combined with an understanding of the regional physiography and stream channel patterns, guided the design of the planform geometry.

The new channel configuration will allow for passage of anadromous fish species identified as potential inhabitants of the study area. Furthermore, it will provide unrestricted access to approximately 5.2 linear miles of aquatic habitat, which has not existed for over 350 years because of a series of dams constructed at the site.

A constraint that affects the river profile is a buried sewer pipe that underlies the park and impoundment a short distance (approximately 70 feet) downstream of the Broad Street Bridge (See Figure 18). The sewer tile imposes a constraint on bed elevation and may necessitate some channel protection in the vicinity of the pipe to protect the pipe from exposure and damage. According to Utility information provided by the city of Stamford, the elevation of sewer line under the river (approximately 9.2 feet at top of tile pipe) is below the final proposed elevation of the channel bed (approximately 10 feet) at the location of the sewer crossing. As shown in Section 5.2 and Appendix B, FEMA flood elevations are not increased by this modification.

A stormwater drain that currently runs along the east side of Mill Pond and outfalls through the face of the dam would be partially removed during excavation (see Figure 18). The outfall of this stormwater drain would be relocated within the park, and the design would include appropriate protection measures, grating, visual screening, and a sediment trap (if necessary). Another storm drain currently drains into the pond through the retaining wall on the west side of the pond, and the outfall of this pipe would be redesigned and relocated with the wall removed. Details on the location and design of the relocated stormwater drain pipes and outfalls would be designed during the plans and specifications phase of the project.

The retaining wall directly downstream of Main Street Dam on the west side of the river (Site 11) may need additional stone protection and reinforcement after the dam is removed. This wall is connected to the dam and wall upstream of the dam. Additionally, the river flow would need to be diverted away from the wall after the dam is removed, because the river takes a bend to the east at this wall and the wall is on the outside of the bend, where higher flow velocities may be encountered.

The banks of the restored channel within the park would be protected, as appropriate, with bioengineering methods and boulders. The configuration and types of bank protection measures will be designed during the plans and specifications phase of the project. Bioengineering methods may include stone-reinforced toes, coir fascines, live stakes, and erosion-control fabric. Engineering Manual (EM) 1110-2-1205 (U.S. Army Corps of Engineers 1989) states that herbaceous or woody vegetation may be used to protect channel side slopes and other bank areas where velocities are not expected to exceed 6 to 8 feet per second. The Maximum-recorded velocities sustained for root wads with large clumps of willows averaged 8.7 feet per second (Allen, 1997). Similar bioengineering techniques would be utilized in the proposed project design. The design would tailor vegetation types and bioengineering structures to flow velocities that can be sustained. Flow velocities in the project area are calculated to be an average of 7 feet per second for the 100-year event, and these flows are within the range of recommended guidelines. However, additional soil stabilization measures are recommended to further stabilize the project area and reduce vulnerabilities during the vegetation establishment period.

Bank stabilization and floodplain restoration would be primarily achieved through the planting of native vegetation, including trees, shrubs, and herbaceous riparian and wetland species Table 11 lists potential plantings for tree species within the newly restored floodplain. Table 12 lists potential plants for banks and floodplains.

Table 11. Potential Tree Species for Floodplain Restoration within Mill River Park

Scientific Name	Common Name
Acer saccharinum	Silver maple
Betula allegheniensis	Yellow birch
Betula nigra	River birch
Carpinus caroliniana	Ironwood
Fraxinus pennsylvanica	Green ash
Juglans nigra	Black walnut
Magnolia virginiana	Swamp magnolia
Nyssa sylvatica	Black gum
Ostrya virginiana	Hop hornbeam
Pinus strobus	White pine
Platanus occidentalis	Sycamore
Populus tremuloides	Quaking aspen
Prunus serotina	Black cherry
Quercus bicolor	Swamp white oak
Salix nigra	Black willow
Tilia americana	Basswood
Viburnum prunifolium	Blackhaw viburnum

Table 12. Potential Herbaceous and Shrub Species for Bank Stabilization and Floodplain Restoration

Scientific Name	Common Name
Herbaceous Perennials	
Chelone glabra	White turtlehead
Caltha palustris	Marsh marigold
Iris versicolor	Blue flag
Leersia oryzoides	Rice cut grass

Scientific Name	Common Name
Herbaceous Perennials	
Lobelia cardinalis	Cardinal flower
Mimulus ringens	Monkey flower
Peltandra virginica	Arrow arum
Pontederia cordata	Pickerel weed
Carex stricta	Tussock sedge
Carex crinita	Fringed sedge

Scientific Name	Common Name
Shrubs/Woody Vines	
Alnus serrulata	Alder
Cephalanthus occidentalis	Buttonbush
Clethra alnifolia	Summersweet
Cornus amomum	Silky dogwood
Cornus sericea	Red osier dogwood
Ilex glabra	Inkberry
Ilex verticillata	Winterberry
Itea virginica	Virginia sweetspire
Kalmia angustifolia	Sheep laurel
Rhododendron periclymenoides	Pinxterbloom azalea
Rhododendron viscosum	Swamp azalea
Spiraea alba	Meadowsweet
Spiraea tomentosa	Hardhack spirea
Vaccinium angustifolium	Lowbush blueberry
Vaccinium corymbosum	Highbush blueberry
Viburnum trilobum	American cranberry bush
Vitis riparia	River grape

A detailed survey of the trees adjacent to the retaining walls was performed (See Appendix I). Of a total of 100 trees surveyed, 80 trees are kwanzan oriental cherry. Most of the trees (85 of the 100 surveyed) are between 30 and 60 years old, including 79 out of the 80 cherry trees. In general, the cherry trees within the park showed various levels of deterioration due to age, growth limitations, and disease. Growth limitations identified during field investigations include proximity to paved and concrete sidewalks, other structures, and other trees.

Removal of the walls and excavation as part of the river channel restoration would require removal of a number of cherry trees within the park. Many trees are located directly adjacent to the retaining walls, some within one foot of the walls. Those trees that have trunk or root structures in proximity to the retaining walls could be damaged during the construction phase and could require removal. The number of trees to be removed would be dependent upon the final alignment of the channel, floodplain, and banks. Of the trees identified for removal in the final design, some may be transplanted to new locations in the park, subject to the capability of the trees to survive transplanting. However, the survey indicated that over half the cherry trees might not be in a condition to survive transplanting. Replanting cherry trees throughout the new park would be the decision of the city of Stamford. For more information on the condition and health of cherry trees within Mill River Park, see Appendix I.

7.1.2 Landscape Design and Recreational Components

Redesign of the Mill River Park, in conjunction with the restoration of the river corridor, presents an important opportunity to restore a functional relationship between the city and Mill River, i.e., to re-integrate cultural and ecological processes. Regulations for the ecosystem restoration authority under which this project is being conducted allow recreational development to be included as part of the project, as long as it is compatible with the ecosystem restoration purpose of the project (see Regulations ER 1165-2-501 and ER 1165-2-502 for more information). The proposed recreational improvements meet these requirements. They include the following:

- A hard-surfaced path to replace the existing sidewalk along the pond, which would allow pedestrian flow and connect the trail system to the City's sidewalks and trails
- Gravel surface trails and wooden boardwalks allowing pedestrian access to the river's edge
- Overlooks on the river's edge constructed of boulders to provide viewing opportunities of the river
- Signs and kiosks to provide information and interpretation
- Benches and trash receptacles

These facilities would allow people to enjoy and learn about the restored riverine environment. They would also help to protect the site from pedestrian-related impacts by providing paths and access points in appropriate locations and minimizing trampling of vegetation and erosion caused by informal trails.

The design and location of cultural elements in the park would relate to ecological and hydrologic cycles and events. The strategic placement of recreational paths (as well as their material properties) would be designed to withstand flooding while also providing controlled public access to and enjoyment of the restored site. The lower elevations of the restored floodplain surfaces would be subject to flooding with an average two-year recurrence interval; therefore, trails and other improvements on the floodplain portions would need to be designed to withstand this interval of flooding. Wooden boardwalks and river-rock piers would be constructed adjacent to the river's edge, and would be designed to withstand flooding while allowing public access to and viewing of the river. Asphalt paths would delimit the edges of typically flood-free zones. A path on the west side of the river would be connected to the City's trail and sidewalk system along Mill River Street, including the City-provided trail connecting to Main Street Bridge pedestrian crossing. A system of smaller, secondary trails would provide opportunities for a more intimate experience of the river system, allowing direct access to key habitat features, as well as the water itself. The kiosks and signs would provide information about the restored site and opportunities for interpretation of the restored ecosystem and history of the area.

The city could also add other recreational and cultural elements to the restored corridor that do not deter from the ecosystem function and are not included in the shared-cost restoration project. These additional elements could include public art works.

The city of Stamford would have the opportunity to re-develop those portions of the park outside the restored corridor. This re-development would not be cost-shared as part of the restoration project. Potential additions to the park outside the restored area (that would not be cost-shared) could include landscaped plantings, including groves of ornamental cherry trees; overlooks to the river corridor; performing arts space, multipurpose open space for picnicking and informal outdoor sports; a community garden and orchard; a farmers market; and a multipurpose paved area that could accommodate uses such as parking and market or craft festivals.

7.1.3 Tidal Wetland Restoration

Two sites for tidal wetland restoration are found south of the Main Street Dam. These areas are both approximately 0.4 acres in size, are currently dominated by *Phragmites*, and provide little habitat value (Plate 7).

The proposed restoration is expected to enhance the habitat available for Mill River fish and wildlife. Native marsh vegetation would be restored, allowing the system to be utilized by additional avian and marine species. Additional information, including existing site plan and topography, salinity levels, and tidal range, needs to be determined before final design can be completed.

The tidal, brackish environment of a salt marsh supports unique and abundant communities of plants and animals specially adapted to life in the sheltered waters of the estuary. Estuarine and salt marsh systems are among the most productive ecosystems on Earth, producing more organic matter than forest, grassland, or agricultural lands of comparable size. The restored tidal wetland habitat would help support a wide array of wildlife including shorebirds, fish, crabs, clams and other shellfish, marine worms, sea birds, and reptiles. The restored wetlands may benefit humans through activities such as recreation, education, and aesthetic values.

Plate 7. Area dominated by *Phragmites* within tidal reach of Mill River

Phragmites australis, also known as common reed, is a tall perennial grass found on all continents except Antarctica. It is characterized by its towering height of up to 14 feet, and its stiff wide leaves and hollow stem. Its feathery and drooping inflorescences form on the top of the plant and resemble plumes. *Phragmites* flowers from July to October but inflorescences may remain visible throughout the year, making the plant easily identifiable. *Phragmites* is a colonial plant, spreading by rhizomes (underground stems) and capable of forming large stands or colonies arising from one or a few seeds or plant pieces. These colonies form along the margins of streams and in marshes and ditches. They can form in brackish water and in disturbed areas, allowing them to out compete other more desirable plants (Marks *et al.* 1993). *Phragmites* has a low ecological value for fish and wildlife habitat combined with a low aesthetic value for people. Because of an abundance of dry matted organic matter, *Phragmites* stands are a constant fire threat that poses a public safety and maintenance concern. A constant tidal flush through a system can eliminate or prohibit the growth of *Phragmites* in a salt marsh system due to its inability to withstand high salinity levels.

The physical form, or morphology, of a site is important to salt marsh restoration, since the physical form interacts with site hydrology to produce conditions favorable for salt marsh plant growth. Salt marsh morphology is determined by such attributes as elevation, slope, micro- and macrotopography, and the presence/absence of channels. A list of potential plant species for tidal wetland areas is listed in Table 13.

Table 13. Potential Plant Species for Tidal Wetland Areas Restoration

Scientific Name	Common Name	Habitat Type
Distichlis spicata	Spike grass	High marsh
Iva frutescens	High-tide bush	High marsh
Juncus gerardii	Black grass	High marsh
Panicum virgatum	Switchgrass	Marsh/upland edge
Scirpus robustus	Salt marsh bulrush	Marsh/upland edge
Spartina alterniflora	Smooth cordgrass	Low marsh
Spartina patens	Salt hay grass	High marsh
Spartina pectinata	Slough grass	Marsh/upland edge

As part of the tidal marsh restoration, a gravel trail and boardwalk are proposed for construction along the upper margins of the marsh areas. This trail system replaces existing trails along the river, and it is necessary to limit pedestrian use in the area and protect the restored sites from trampling and informal trail development. The trail system would also provide opportunities for interpretation and education about the marsh ecosystem.

7.1.4 Riparian Corridor Restoration

Riparian corridor restoration would provide ecological benefits to the aquatic, riparian, and terrestrial ecosystems. Ecological benefits include moderation of stream temperature, bank stabilization, and maintenance of the floodplain.

Riparian restoration includes removal of invasive species and rehabilitation of noteworthy trees within the corridor. The primary invasive species of concern are Japanese knotweed and purple loosestrife. Japanese knotweed in particular is a persistent and fast growing exotic species that has colonized whole sections of the riparian corridor, inhibiting native vegetation and limiting diversity. Management techniques include chemical and manual removal and planting of fast growing groundcover and shade trees. The short-term success of exotics management depends on continual maintenance for specified areas.

Riparian corridor restoration is proposed for the Mill River, including 4.0 acres in the Mill River Park and 1.53 acres (Sites 9, 10, and 18) totaling approximately 5.53 acres. Hardwood and floodplain species would be planted and exotic species removed within a 20-foot corridor adjacent to the river channel and within Scalzi Park. All of the other riparian areas impacted by construction will be restored as well. Restoration would include planting native riparian species where canopy cover is less than 80%. All plantings would be performed in the appropriate season and upon completion of any earthmoving activities in the area. A qualified expert would assess the exact location and density of riparian plantings during the design phase. Table 14 lists potential plants for riparian planting.

As part of the riparian corridor restoration, a gravel trail is proposed for construction along the upper margins of the riparian area. As in the tidal marsh area, this trail system replaces pedestrian trails existing along the river, and it is necessary to limit pedestrian use along the river and protect the restored sites from trampling and informal trail development.

Table 14. Potential Plant Species for Riparian Restoration

Scientific Name	Common Name	Type
Acer saccharinum	Silver maple	Tree
Alnus serrulata	Alder	Shrub
Betula allegheniensis	Yellow birch	Tree
Betula nigra	River birch	Tree
Caltha palustris	Marsh marigold	Herbaceous perennial
Carpinus caroliniana	Ironwood	Tree
Cephalanthus occidentalis	Buttonbush	Shrub
Chelone glabra	White turtlehead	Herbaceous perennial
Clethra alnifolia	Summersweet	Shrub
Cornus amomum	Silky dogwood	Shrub

Table 14. (cont.) Potential Plant Species for Riparian Restoration

Scientific Name	Common Name	Type
Cornus sericea	Red osier dogwood	Shrub
Fraxinus pennsylvanica	Green ash	Tree
Ilex glabra	Inkberry	Shrub
Ilex verticillata	Winterberry	Shrub
Iris versicolor	Blue flag	Herbaceous perennial
Itea virginica	Virginia sweetspire	Shrub
Juglans nigra	Black walnut	Tree
Kalmia angustifolia	Sheep laurel	Shrub
Leersia oryzoides	Rice cut grass	Herbaceous perennial
Lobelia cardinalis	Cardinal flower	Herbaceous perennial
Magnolia virginiana	Swamp magnolia	Tree
Mimulus ringens	Monkey flower	Herbaceous perennial
Nyssa sylvatica	Black gum	Tree
Ostrya virginiana	Hop hornbeam	Tree
Peltandra virginica	Arrow arum	Herbaceous perennial
Pinus strobus	White pine	Tree
Platanus occidentalis	Sycamore	Tree
Pontederia cordata	Pickerel weed	Herbaceous perennial
Populus tremuloides	Quaking aspen	Tree
Prunus serotina	Black cherry	Tree
Quercus bicolor	Swamp white oak	Tree
Rhododendron periclymenoides	Pinxterbloom azalea	Shrub/vine
Rhododendron viscosum	Swamp azalea	Shrub/vine
Salix nigra	Black willow	Tree
Spiraea alba	Meadowsweet	Shrub/vine
Spiraea tomentosa	Hardhack spirea	Shrub/vine
Tilia americana	Basswood	Tree
Vaccinium angustifolium	Lowbush blueberry	Shrub/vine
Vaccinium corymbosum	Highbush blueberry	Shrub/vine
Viburnum prunifolium	Blackhaw viburnum	Tree
Viburnum trilobum	American cranberry bush	Shrub/Vine
Vitis riparia	River grape	Shrub/vine

7.1.5 Removal of Obstruction at Pulaski Street Bridge

Currently, a large concrete platform and abandoned weir structure exist under and slightly upstream of Pulaski Street Bridge (see Plate 8). The affected reach of channel is approximately 300 feet. This structure becomes a complete impediment to fish passage during mid to low tides, so anadromous fish and other aquatic species have limited upstream passage only during high tides. The recommended plan includes removal of all of the abandoned structure in the river and restoring the natural stream channel through the affected reach. The construction requires staging area setup along the channel's edge, demolition of the concrete structure (estimated 556 cubic yards), and hauling and disposal of the concrete at a suitable location selected by the city of Stamford.

Plate 8. Concrete obstruction under Pulaski Street Bridge on the Mill River in Stamford, CT. This abandoned structure blocks fish passage during mid and low tides.

7.2 DESIGN ASSUMPTIONS

The following assumptions are made for consideration in finalizing the recommended plan and during the plans and specifications phase:

1. Additional site-specific topographic, hydrologic, geotechnical, and geohydrological information will be required for each site during the design and specifications phase.
2. The public outreach process may result in the identification of revisions to the recommended plan.
3. Removal of the Main Street Dam and retaining walls would occur during a low flow period. Water diversion would be necessary during construction. A water diversion and control plan would be developed during the design phase.
4. Erosion and sedimentation control would be required at all restoration locations to prevent migration of sediments downstream. Due to fluctuating water levels in the tidal area downstream, a floating silt curtain would be used to enclose the work area.
5. Approximately 18,600 cubic yards of sediment built up behind the dam would be removed before dam removal, and the sediment would be disposed of at one or more approved sites. If necessary, sediment would be additionally tested. All materials determined inappropriate for disposal in residential and/or industrial/commercial areas would be transported to an approved site such as the Manchester Municipal Landfill. The cost estimate in this report assumes disposal of all 18,600 cubic yards in the Manchester Landfill.
6. The 2,200 feet of retaining walls are assumed to be almost completely removed, and the cost estimate reflects removal and disposal of all the wall material, including the footings. However, as a cost saving measure, portions of the walls could remain in place where those portions of walls are below final grade. The estimated quantity of wall to be removed is based on the cross sectional designs shown in the historical plan (Figure 3).
7. All other wood, metal, concrete, and miscellaneous debris from the demolition of the dam, retaining walls, and associated structures would be disposed of off-site at an approved site selected by the project sponsor. The material is assumed to be uncontaminated, or easily cleaned, and be suitable for upland disposal or recycling.
8. Approximately 26,000 cubic yards of material, currently behind the retaining walls of the pond will be regarded to form the subgrade of the new channel floodplains and upper terraces. This material is assumed to be suitable for this purpose. Some sorting out of larger material is assumed.
9. Control of resident geese would be needed during planting and landscaping, and would be continued through key growth years for the restoration areas.
10. Restoration of the tidal wetlands is estimated to require excavation 3 feet of plant material and soil from of 0.8 acres of riparian area currently vegetated with Phragmites. This sediment has an estimated volume of 3,900 cubic yards and is assumed to be suitable for upland disposal. Further testing may be necessary to determine this suitability and to finalize the location of the disposal site. Approximately 1,300 cubic yards of loam or topsoil would be added to the wetlands sites after excavation.

7.3 PRELIMINARY CONSTRUCTION REQUIREMENTS

Restoration of a free flowing river would require the following:

1. Placement of sediment control and flow control structures and draining the impoundment
2. Dewatering, excavation, and disposal of sediment from behind the dam
3. Demolition, removal, and disposal of the concrete dam structure (560 cubic yards)
4. Demolition, removal, and disposal of the concrete retaining walls (up to 2,300 cubic yards)
5. Demolition, removal, and disposal of concrete sidewalk (approximately 500 cubic yards)
6. Removal of existing trees in areas to be excavated, including the possible transplanting of select cherry trees along the pond (those that are healthy and can be dug successfully without substantial damage)
7. Excavation, filling, regrading, and stabilization of over 2,200 feet of channel to achieve an appropriate bankfull channel geometry, planform, and channel gradient that creates a free-flowing stream in the former Mill River Park
8. Partial removal of at least two storm drains and construction of at least two relocated outfalls into the river
9. Placement of channel bed materials, including gravel, cobbles, and boulders
10. Protection of the sewer tile pipe that crosses under the river by placing appropriately sized rock material over and downstream of the pipe
11. Placement of boulders and bioengineering treatments along the banks and within the floodplain
12. Construction of gravel and paved trails to replace existing sidewalks and trails, construction of boardwalks to access the edge of the river, and installation of other recreational improvements, such as kiosks and benches
13. Revegetation of the riparian corridor with native plant species
14. Post-construction monitoring

Restoration of the two tidal wetland sites (0.8 acres total) would require the following:

1. Excavation of approximately 3 feet of overbank sediments and Phragmites vegetation and roots from the two tidal benches (3,900 cubic yards)
2. Top dressing the sites with 6 inches of loam or topsoil (1,300 cubic yards)
3. Mulching and placement of erosion control matting and other erosion control methods
4. Revegetation with native tidal marsh plantings
5. Installation of gravel trails with boardwalk sections along the upper edge of the tidal marsh

Restoration of 1.53 acres of riparian corridor would require the following:

1. Removal of invasive vegetation (approximately 0.36 acres)
2. Planting native vegetation: tree saplings and herbaceous plantings
3. Erosion control matting and mulch installation
4. Installation of an overlook and gravel foot paths along the riparian corridor

Removal of the concrete blockage at Pulaski Street Bridge would require:

1. Demolition and excavation of approximately 560 cubic yards of concrete from the river channel with removal taking into consideration low tide periods
2. Hauling and disposal of the concrete material in a site designated by the city of Stamford

Construction would take approximately 12 months to complete, including 20 working days for mobilization and dewatering; 20 working days for sediment removal and relocation; 80 working days for demolition and disposal; 20 working days for excavation, grading, mechanical work and slope stabilization; 50 working days for planting, exotic species removal, and walkway construction; and 20 working days for cleanup and demobilization.

Disturbed areas above the bankfull channel elevation would be revegetated using native riparian vegetation as indicated on the planting plan. Before final grading, topsoil, amended as needed, would be spread and fertilized to provide an appropriate planting medium with a minimum total organic content of 4-6 percent. Soil would be tested to ensure adequate fertility before planting. Planting would be limited to the spring planting season from April 15 to June 15.

7.4 MONITORING

Monitoring of the restoration sites both prior to construction and following restoration will allow the federal government and the local sponsor to quantify and evaluate the affects of restoration. Monitoring would occur throughout the construction period and three to five years after construction completion to ensure that the river channel has been restored successfully and anadromous fish passage is successful. One monitoring requirement includes ensuring the survival of planted riparian and wetland species. Another requirement would be to ensure that the river channel and banks are stable. Monthly visits to the site during the initial growing season would ensure that plant materials are appropriately established and would allow quick remedial action if necessary. Visits to evaluate plant success would include an evaluation of the bioengineering treatments used to stabilize the channel. Fish and other aquatic life would be monitored during appropriate seasons to evaluate the effectiveness of restoring the aquatic habitat and to ensure that anadromous fish passage is successful. Site visits would be needed following major storm events that produce near, or greater than, bankfull conditions, or until the vegetation matures.

Federal cost sharing of monitoring costs is limited under Corps Regulation ER-1105-2-100, Appendix F. Cost-shared monitoring costs are normally limited to a maximum of 1% of the total project costs. The cost-shared monitoring costs are estimated to be $55,000. Monitoring would be conducted over at least the first three years after project construction is completed.

7.5 OPERATIONS AND MAINTANENCE

As with all ecologically based projects, long-term success requires continued operations and maintenance of the restored sites. Operation, maintenance, repair, rehabilitation, and replacement (OMRR&R) would be the sole responsibility of the non-Federal sponsor.

Wetland berms and any flow control structures would be checked for operation and maintenance needs. The control of resident Canada geese populations would also be a key component to the success and viability of the Mill River Park restoration. The sites need to be inspected periodically for invasive weed reintroduction. Any invasive weeds that are returning to the sites would need to be removed.

The sponsor would also be responsible for maintenance and repair of the trails, piers, boardwalks, signs, and other improvements that are part of the project.

7.6 REAL ESTATE REQUIREMENTS

Real estate costs in the study area are reflective of real estate values in urban centers of the Northeastern United States. USACE policy guidance generally requires acquisition of real estate in fee for restored sites. The recommended plan includes four major elements to the Mill River and Mill Pond Habitat Restoration Project, which are river corridor restoration in Mill River Park, riparian corridor improvements, tidal wetland restoration, and removal of impediments to fish passage. These four elements occur on nine different sites, which are composed of 12 real estate parcels. For this project, parts of two parcels (0.99 acres total) are proposed for the fee title to be held by the city of Stamford: part of Scalzi Park (0.36 acres) and part of Roger Smith Park (0.63 acres). The city owns the two parks and would be credited for any reduced appraised value to the parcels as a result of restoration restrictions and operations and maintenance requirements. Portions of nine parcels affected by the project require temporary construction easements totaling 4.21 acres to provide access to the restoration sites. These access sites are owned by the city of Stamford (some through its Housing Authority), the State Department of Education, and the State Department of Transportation.

An estimate of the affected values of the real estate to be acquired or held for the project implementation is presented in the Real Estate Report (Appendix G). The total real estate value of affected properties is estimated at $256,000. An additional $5,000 is added to the total cost of real estate for costs associated with real estate acquisition, for a total real estate contribution of $261,000. For purposes of valuing the temporary construction easements, an estimate of 10% of the per-acre land value of the parcel was used, based on communication with local officials. See Appendix G for more information.

7.7 TOTAL PROJECT COST ESTIMATE

Estimated total project cost-shared cost of $5,571,000 includes the costs of the DPR and EA ($350,000), plans and specifications ($380,000), construction ($ 4,525,000), real estate values that can be cost-credited by the sponsor ($261,000), and post-construction monitoring (55,000). Table 15 outlines the costs.

Construction-cost estimates are shown in Table 16. Appendix F provides greater detail of construction costs. Construction costs include field overhead (10%), home office overhead (6%), profit (10%), bond (1.5%), and contingency (15%). Escalation costs are not included. USACE project management expenses were estimated at approximately 11% of total project costs. Project management includes engineering ad design during construction, estimated at $122,000, and construction management, estimated at $320,000. Construction costs were estimated using the Unit Price database file in the MCASES software program, the 2003 RS Means construction cost guides, and verbal and written cost estimates, including written estimates for dewatering and disposal of the Mill Pond sediments. An MCACES-software cost analysis is provided in Appendix F.

Total recreational improvement costs that are eligible for cost sharing are estimated at $376,000 including the pro-rated costs of Engineering and Design During Construction and Construction Management. Eligible recreational improvement costs are limited under the Section 206 program to 10% of the ecosystem restoration costs. The $376,000-cost meets this cost limit, since total restoration-related costs are $5,195,000.

Table 15. Preliminary cost summary for Proposed Project.			
		Subtotals	TOTAL
PROJECT STUDY COSTS		$350,000	
PLANS AND SPECIFICATIONS		$380,000	
CONSTRUCTION COSTS			
Mill Pond Park Restoration – River Channel Restoration to Riffle/Pools	$3,597,000		
Removal of Obstruction at Pulaski Street	$150,000		
Riparian Corridor Restoration	$64,000		
Tidal Wetlands Restoration	$272,000		
Engineering and Design During Construction (Approx. 3% of Construction Costs)	$122,000		
Construction Management (Approx. 8% of Construction Costs)	$320,000		
TOTAL CONSTRUCTION COSTS		$4,525,000	
REAL ESTATE VALUE		$261,000	
POST-CONSTRUCTION MONITORING		$55,000	
TOTAL PROJECT-SHARED COSTS			$5,571,000
TOTAL OPERATIONS AND MAINTENANCE COSTS	$7,000 per year for 50-year project life		

Note: a 15-percent contingency cost is built into all cost estimates. Included in Construction costs are: Recreational Improvement Construction Costs of $339,000, plus 3% Engineering and Design Costs of $10,000 and 8% Construction Management Costs of $27,000, for total Recreational Improvement Costs of $376,000.

Table 16. Proposed Project Construction Costs.
The cost estimates shown below for the proposed project include costs for Mill Pond Park restoration with riffle/pool restoration, obstruction removal at Pulaski Street Bridge, tidal wetlands restoration, and riparian corridor restoration.

Restoration Measure	Construction Item		Subtotals	Totals
Mill Pond Park Restoration - Alternative 2 - Restore River Channel to Riffle/Pool	Mobilize/Demobilize - Total		$90,000	
	Impoundment Sediment Testing, Excavation, and Disposal [18,600 cubic yards (c.y.)]		$1,873,000	
	Relocate Utilities and Structures [500 linear feet (l.f.) total plus two outfalls]		$211,000	
	Dam Removal (556 c.y.)		$120,000	
	Reinforce Stonewall below dam (100 l.f.) with stone protection		$18,000	
	Channel Restoration	Retaining Wall (2,200 c.y.) and Sidewalk Demolition (500 c.y.)	$300,000	
		Earthwork (26,200 c.y.)	$299,000	
		Channel Bank Restoration (2,200 l.f.)	$125,000	
		Channel Bed Restoration (2,777 c.y.)	$108,000	
		Subtotal Channel Restoration	$832,000	
	Vegetation Restoration	Tree Removal for Transplant (50 each)	$30,000	
		Restoration Plantings (6 acres total, including 366 trees and 1.1 acres of shrubs and herbaceous plantings)	$180,000	
		Subtotal Vegetation Restoration	$210,000	
	Recreational Improvements	Pedestrian Trail/boardwalk System (Assumes 4,300 l.f. total gravel and bituminous trails and 1,000 l.f boardwalk and foot bridges)	$136,000	
		Recreational and Interpretive Improvements (signs, benches, trash receptacles, wooden overlook)	$107,000	
		Subtotal recreational Improvements	$243,000	
	Total - Mill Pond Restoration			**$3,597,000**
Remove Obstruction at Pulaski Street Bridge	Site Demolition (556 c.y.)		$134,000	
	Hauling and Disposal (556 c.y.)		$16,000	
	Total - Remove Obstruction at Pulaski Street			**$150,000**
Restore Tidal Wetlands	Earthwork (5,800 c.y. total excavation and fill)		$70,000	
	Invasive Vegetation Control (0.8 acre)		$50,000	
	Planting Native Species (0.8 acre total)		$44,000	
	Bank Stabilization (600 linear feet)		$27,000	
	Recreational Improvements (Assumes 1,500 l.f. gravel trail and 700 l.f. boardwalk)		$81,000	
	Total – Tidal Wetlands Restoration			**$272,000**
Restore Riparian Corridor	Invasive Vegetation Removal (0.36 acre)		$6,000	
	Bank Stabilization and Plantings (1.53 acres total)		$43,000	
	Recreational Improvements (Assumes 870 l.f. gravel trail and overlook)		$15,000	
	Total – Riparian Corridor Restoration			**$64,000**
Total Construction Costs				**$4,083,000**

Note: Costs include 15% contingency, 10% field overhead, 6% home office overhead, 10% profit, and 1.5% bond.